
I R
INDUSTRIES, INC.

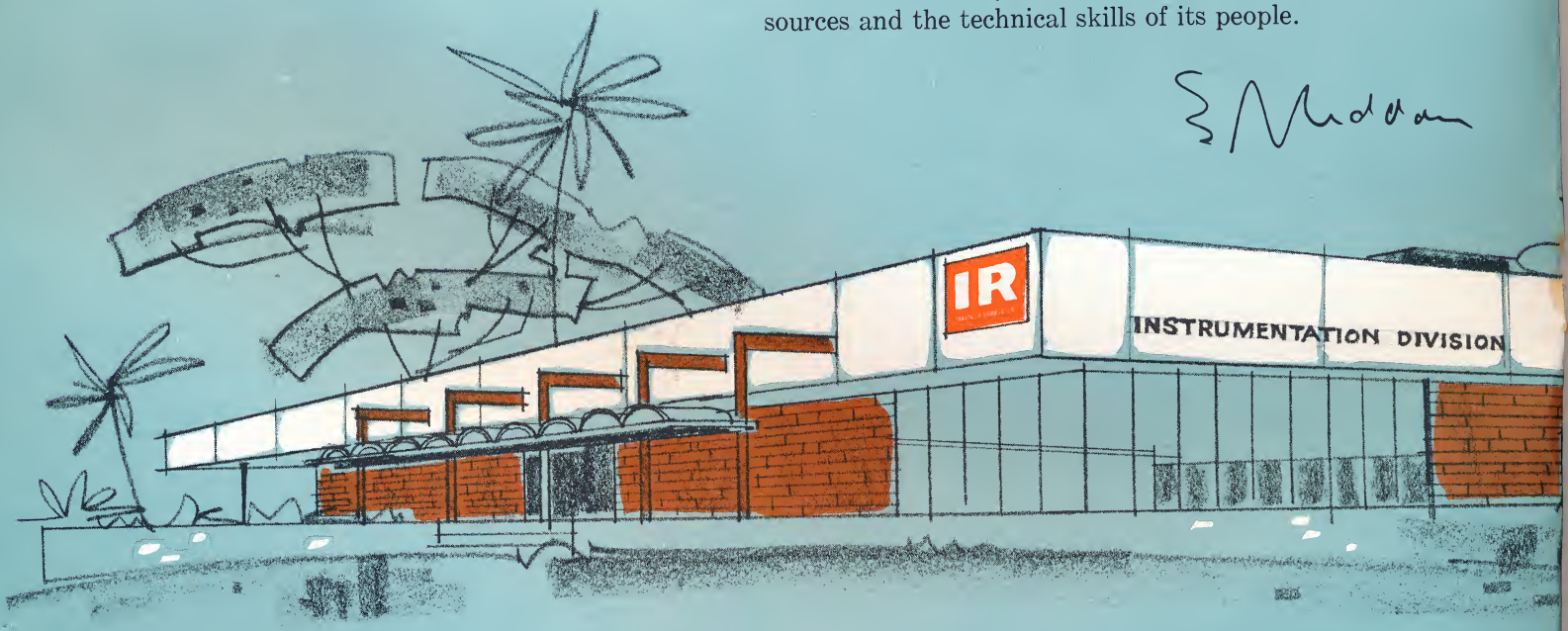
Lowell L. Baskins, Vice President
Norman C. Anderson, Executive Vice President
E. Douglas Reddan, President

The spectrum of technology is broadening and will continue to broaden under the demands of the Nation's missile, space and nuclear programs.

New concepts of navigation, communication and guidance are coming into being. New instruments, capable of operating for long periods under severe environments, are needed for a variety of missions. Space and weight are at a premium and precision and reliability must exceed all standards of the past.

Arising to meet these challenges is the new, dynamic and increasingly important area of technology — *electro-optics.*

It is in this new area — where the creation of techniques and devices for science, industry and the military is limited only by the imagination and prowess of our scientists and engineers and the abilities of our management to use this talent — that Infrared Industries, Inc. has chosen to concentrate its resources and the technical skills of its people.



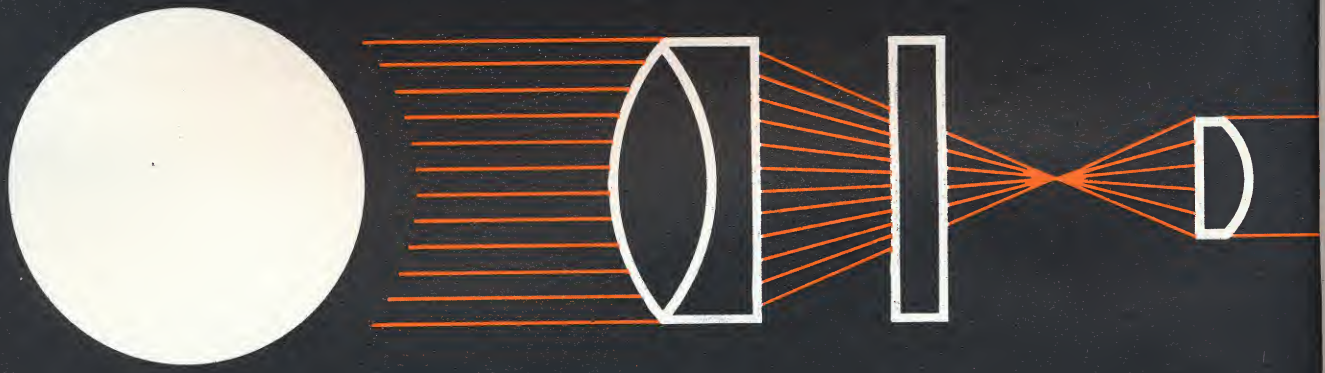
IRI's Santa Barbara operation encompasses Corporate Headquarters, Instrumentation Division and the Simpson Optical Division.

INFRARED INDUSTRIES, INC. . . .
LEADERSHIP IN
ELECTRO-OPTICS

THE SCIENCE AND TECHNOLOGY OF ELECTRO-OPTICS

Concerned chiefly with the wavelength region of electromagnetic radiation from infrared to x-ray the science and technology of electro-optics makes the widest use of the techniques of classical optics and the remarkable advancements in solid state electronics, while relying heavily on related disciplines, from nuclear physics and chemistry to cryogenics and high vacuum. New discoveries and applications in the realm of infrared physics have accelerated the growth of this new science and produced a wide range of electro-optical devices and systems contributing to scientific and industrial advancement.

The modern electro-optical system — represented below — is a highly integrated combination of electronic and optical components precisely designed, manufactured and selected to enable the system as a whole to best perform its task.



SOURCE

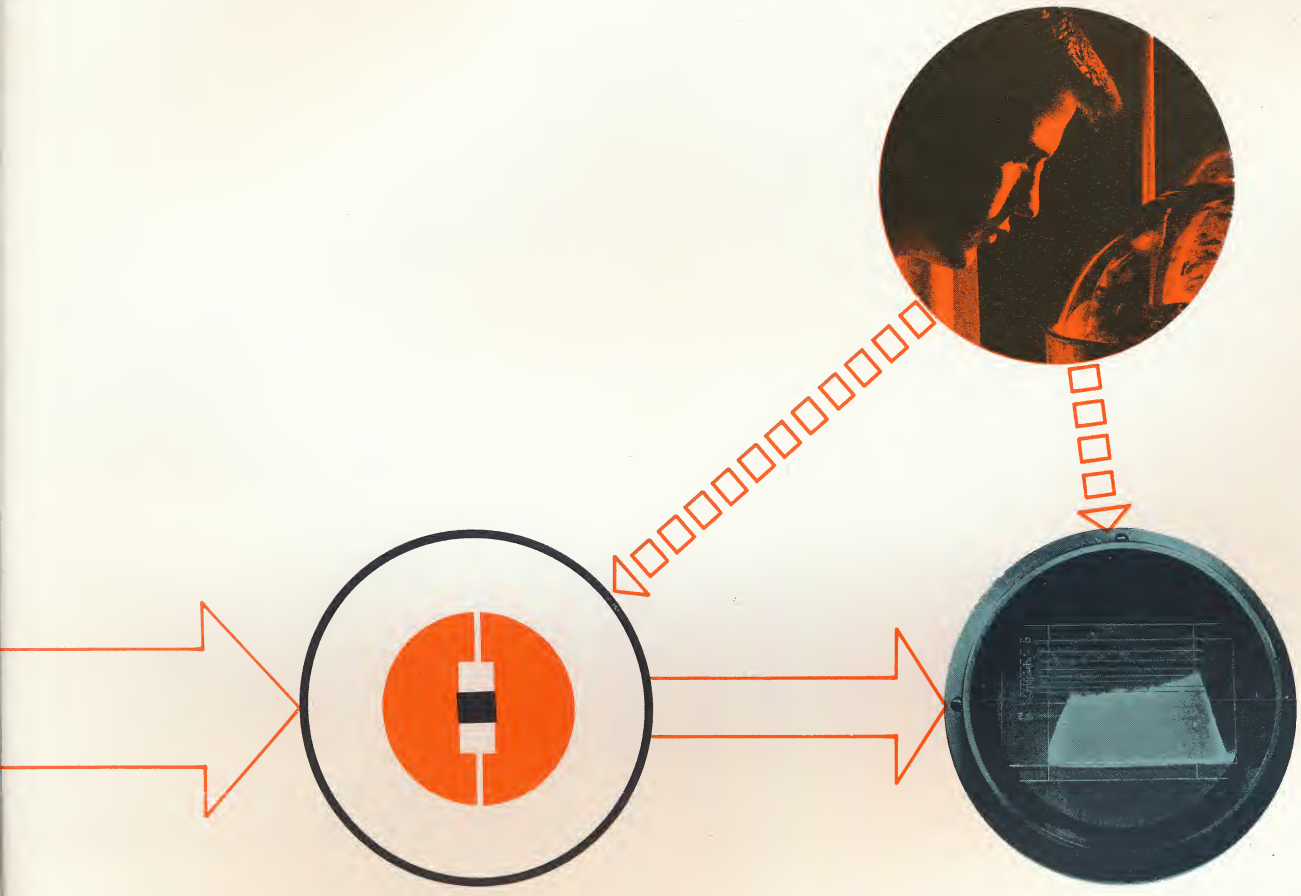
Electromagnetic radiation from far infrared to x-rays.

OPTICS

to acquire, select and focus radiation.

SOLID STATE PHYSICS

key to advanced development of sources, optics, transducers and electronics for electro-optical systems.



TRANSDUCERS

to convert radiant energy to electrical signals.

ELECTRONICS

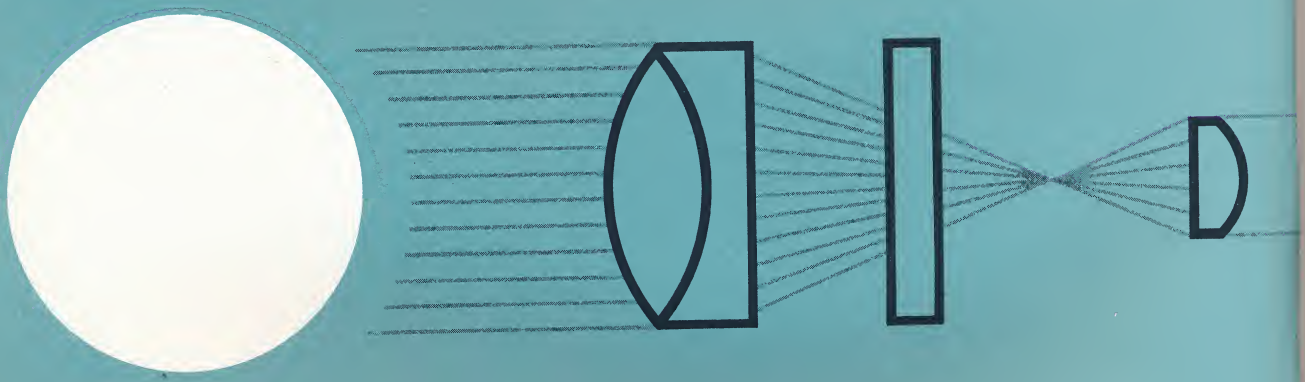
to amplify — measure — analyze — display — actuate.

THE ROLE OF IRI IN ELECTRO-OPTICS

IRI was established in 1957 on the basis that an electro-optical device, the photoconductor, would find increasing application in military systems where the potential of infrared was just beginning to be fully realized. It was envisioned that this fundamental electro-optical sensor would be the beginning of the gradual growth of a capability to conceive, develop and market a broad range of devices based on electro-optical principles.

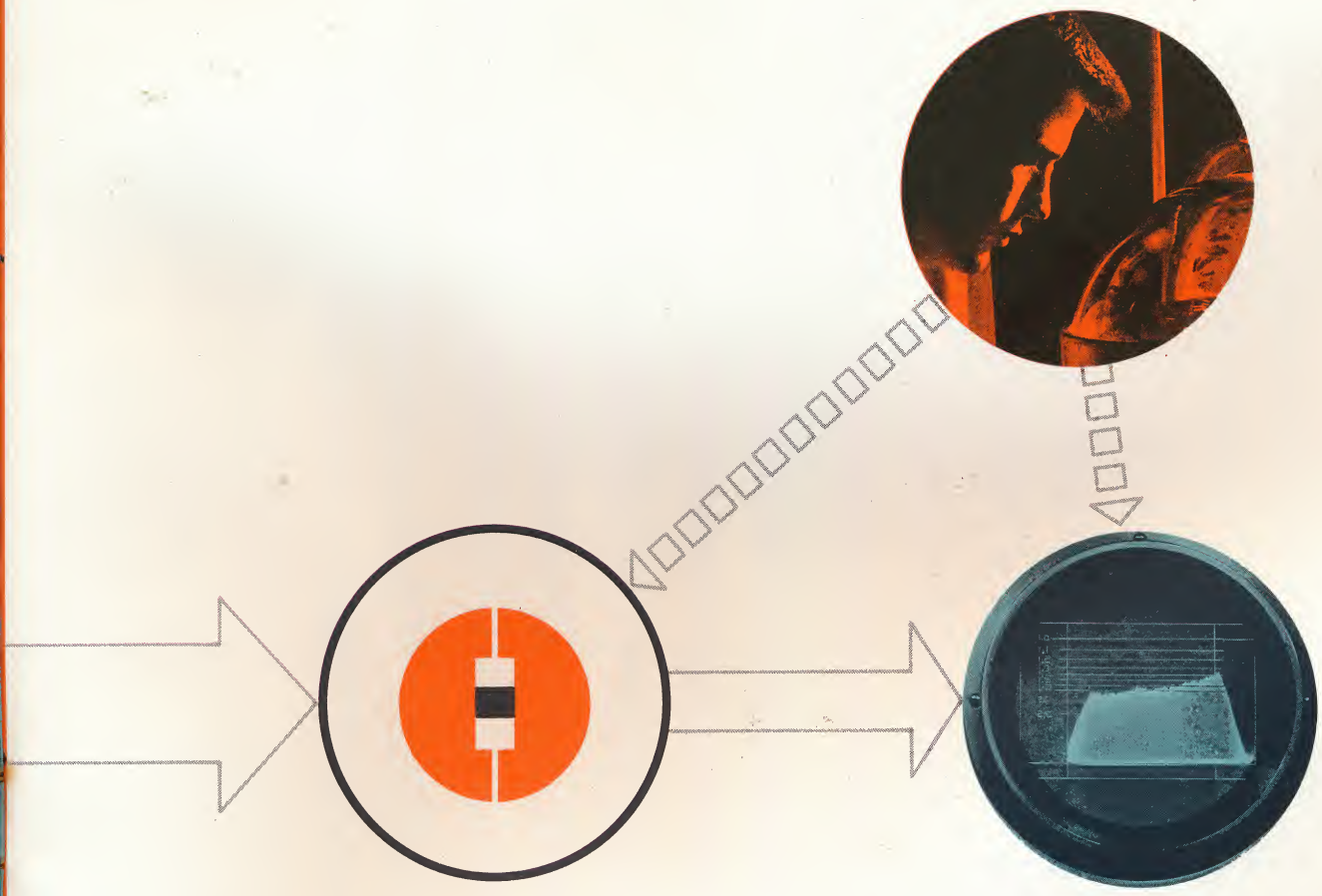
It was recognized that new tools were needed to accurately measure and analyze radiation characteristics and new instruments to monitor and control the functions performed by electro-optical systems. Fulfillment of this need firmly established the technical competence of Infrared Industries in *electronics*. The next major step was to add the professional skills and facilities for development and fabrication of *precision optics* in prototype quantities or in mass production. Later, a nuclear physics group experienced in *solid state technology* significantly broadened the scope of Infrared Industries. Related skills in chemistry, mechanics, cryogenics and high-vacuum were fostered to the extent they supported the basic goals of the Company.

This orderly pattern of growth has led to IRI's *extensive capability in electro-optics* — a balanced organization competently staffed and equipped, advancing the frontiers of science through refinement in measurement, creativity in design and precision in manufacture.



SIMPSON OPTICAL DIVISION

ELECTRO-NUCLEAR
LABORATORIES, INC.



PHOTOCONDUCTOR
DIVISION

INSTRUMENTATION
DIVISION


TRANSDUCERS

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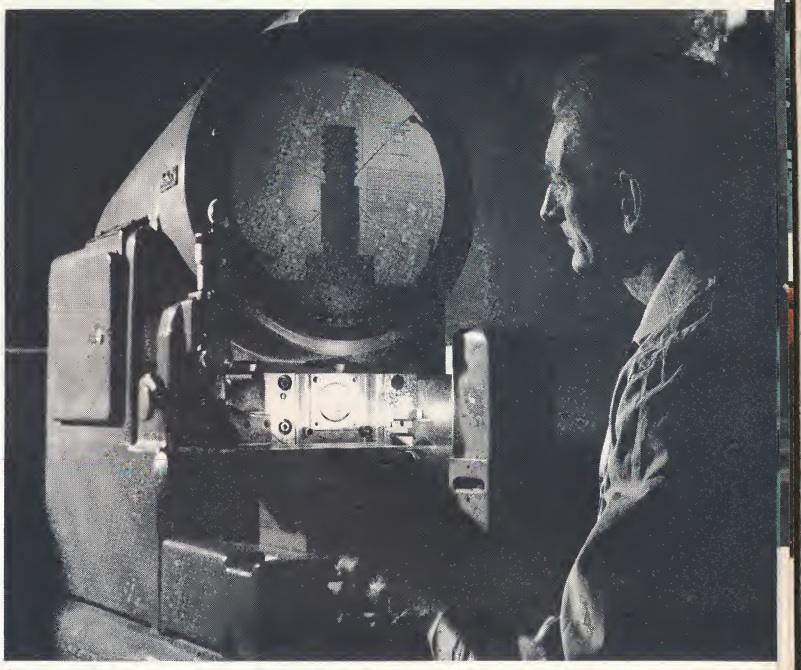
B



C

Infrared Industries' scientific, development and manufacturing skills in transducer technology have played a dominant role in the advancement of military electro-optical systems. Long recognized as the leading producer of infrared sensors for missile and space systems, the Company has moved into the visible, ultra-violet and x-ray portions of the spectrum. Components which have recently issued from our laboratories include high-performance solar energy cells and revolutionary solid state nuclear detectors for space radiation measurements.

The electro-optical transducer bridges the capabilities of high speed, high resolution optical systems and the high-speed, precise communication and control of present-day electronics. IRI research in this field is continually aimed at increasing the operational stability and reliability of the transducer for surface, air and space missions as well as the yield of information derived from the optics.

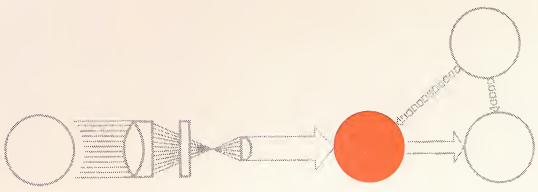
As a principal supplier of miniature detector elements to organizations concerned with satellite payloads, IRI has demonstrated its capability to employ the most advanced techniques of microminiaturization to achieve higher performance in less space and weight. Using specially designed micromanipulation and microwelding equipment, IRI has developed methods for producing sensor arrays of thousands of individual transducer elements in areas less than one square inch. These specially-developed imaging devices provide wide field-of-view, precise resolution and high detectivity, and are compatible with electro-optical multiplexers also under development.

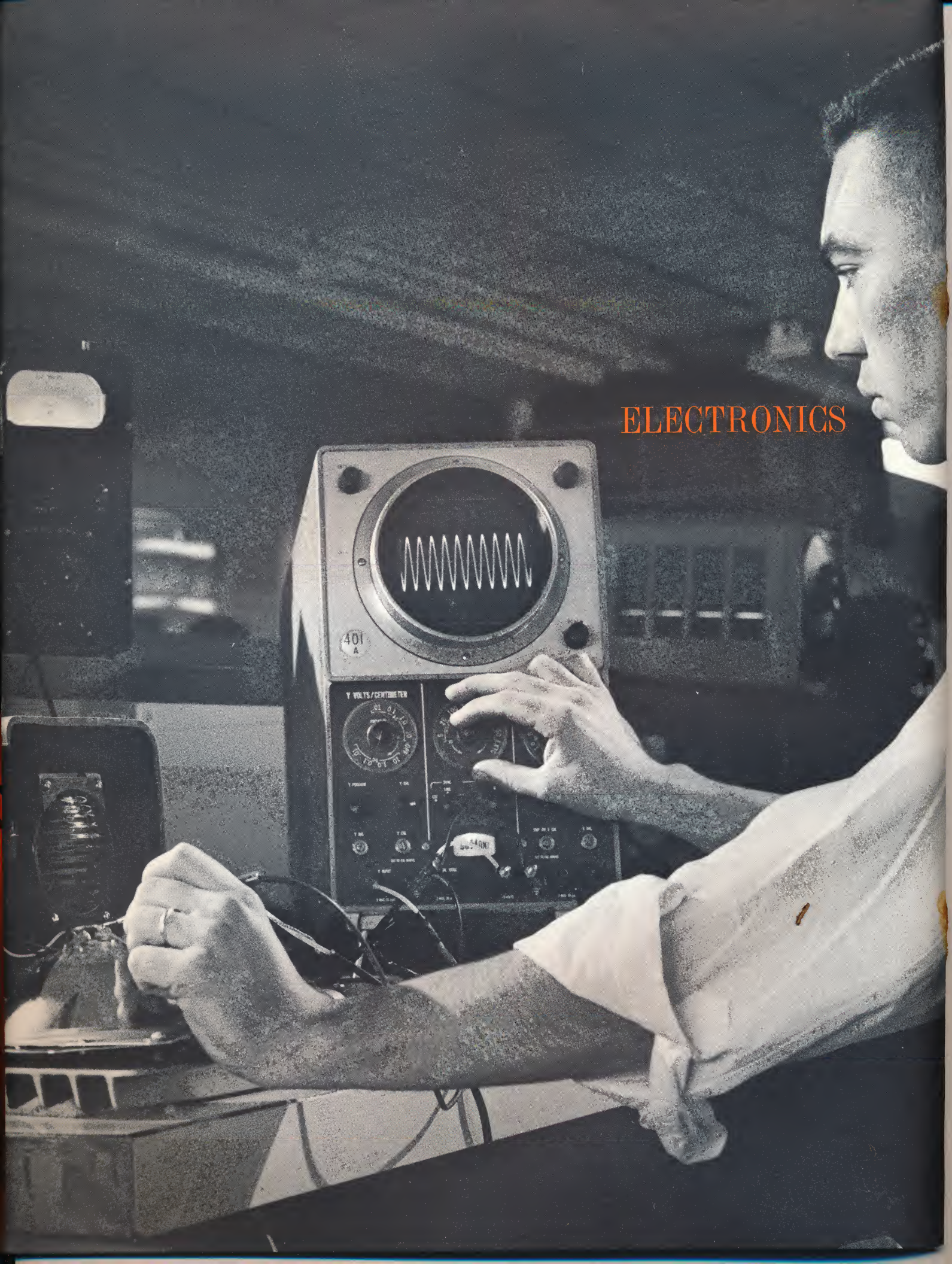
In solving the problems of producing reliable transducers, capable of operation with high sensitivity in a wide range of environments, IRI has acquired a considerable background in chemistry, cryogenics, high vacuum and low-level measurement. The Company's evaluation and testing facility is the largest and best equipped in the industry for photoconductive transducers. Beyond this, the capabilities of our technical staff provide a large, stable reservoir of technical competence for extending the state-of-the-art in design and for low cost volume production of many types of electro-optical transducers.

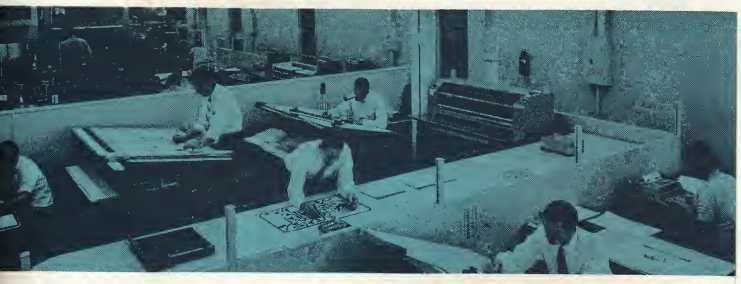
A Specially modified spectrophotometers are used to measure spectral response characteristics of photoconductors in our constant effort to extend the practical usefulness of radiant energy transducers to longer wavelength regions of the electro-magnetic spectrum.

B New transducer designs and materials are continually being investigated in our laboratories, resulting in entirely new detector concepts for advanced systems.

C The extremely fine mechanical tolerances of IRI-designed miniature transducer assemblies for missile systems require the most modern quality assurance equipment.




ELECTRONICS
401
A
Y VOLTS/CENTIMETER



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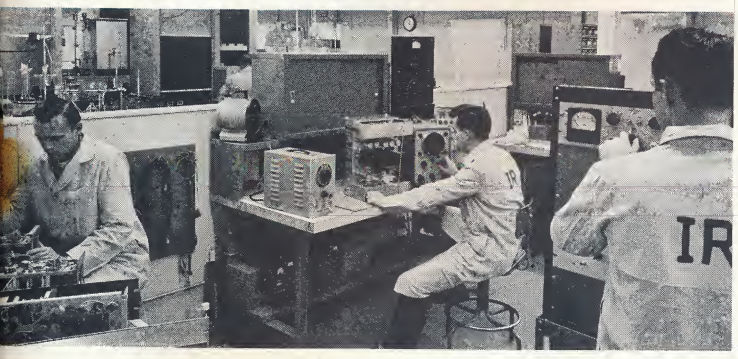

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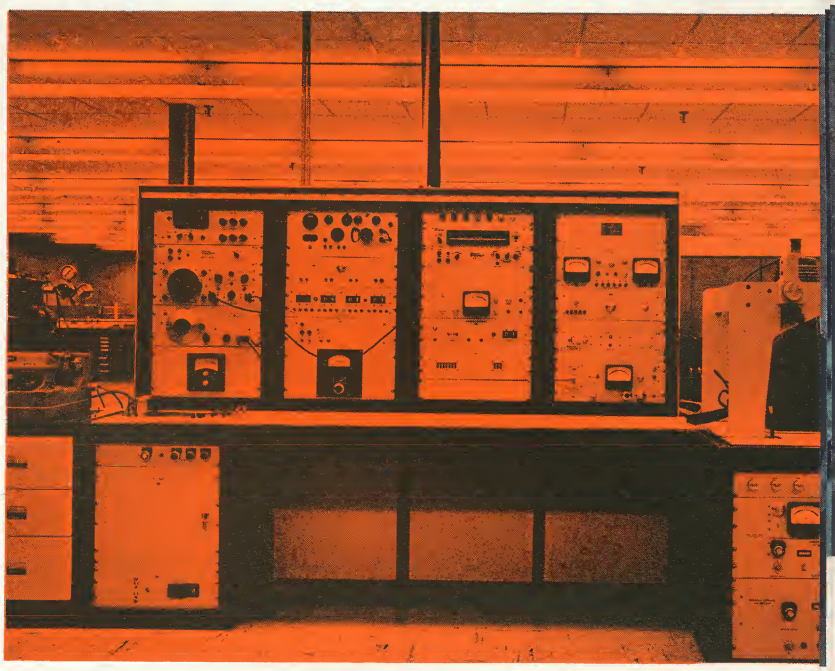


C

In response to the increasing need in science and industry for new measurement and control tools to function within the special parameters of electro-optical technology, Infrared Industries, Inc. has developed an advanced capability in electronics, with particular emphasis on state-of-the-art improvement in techniques for the acquisition and processing of low-level signal information for data analysis and servo control.

The grouping of talents required to design and develop instrumentation and standards for laboratory research and production evaluation of infrared sensors has established IRI as the leader in this field. It has also led to the development and manufacture of a wide variety of instrumentation and components, including solid state subminiature amplifiers which operate with a higher input impedance and lower noise level than ever before offered in the electronics industry; noise integrators with readout devices capable of furnishing non-ambiguous digital values for random noise; electronic temperature controllers with sufficient precision for inclusion in calibrator grade instruments; and complete automatic self-calibrating digital consoles for checkout of the most sophisticated components and instrumentation systems, with test results available in both analog and digital form for on-line analysis and immediate computer entry. This same circuitry is available to close the loop on first order control systems.

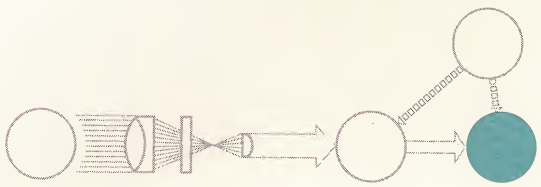
Solid engineering achievements in producing this broad line of instruments and test consoles have provided a firm basis for the application of a diversity of skills to the development of radiation pyrometers, nuclear instrumentation, commercial control electronics, optical comparators, and spectrophotometric equipment. A photoelectric multiplexing system that promises a significant reduction in the electronic circuitry associated with multielement arrays of infrared detectors is now in development.

The acceleration of programs to automate many tasks now performed manually places IRI in a unique position to serve the needs of industry and the military. Each electronic achievement has strengthened IRI's special skills in the challenging field of electro-optics.

A The most advanced packaging and reliability techniques are used throughout IRI's electro-optical designs.

B Our instrumentation engineers concentrate on the design of precise, specialized instruments for low-level signal "problem" measurements.

C Fully-Automatic Checkout Station for production testing of single-unit or array-mounted transducers in large volume. The system digitizes the data for printed readout on paper tape and/or punched cards, thus allowing computer statistical analysis.




SOLID STATE
PHYSICS

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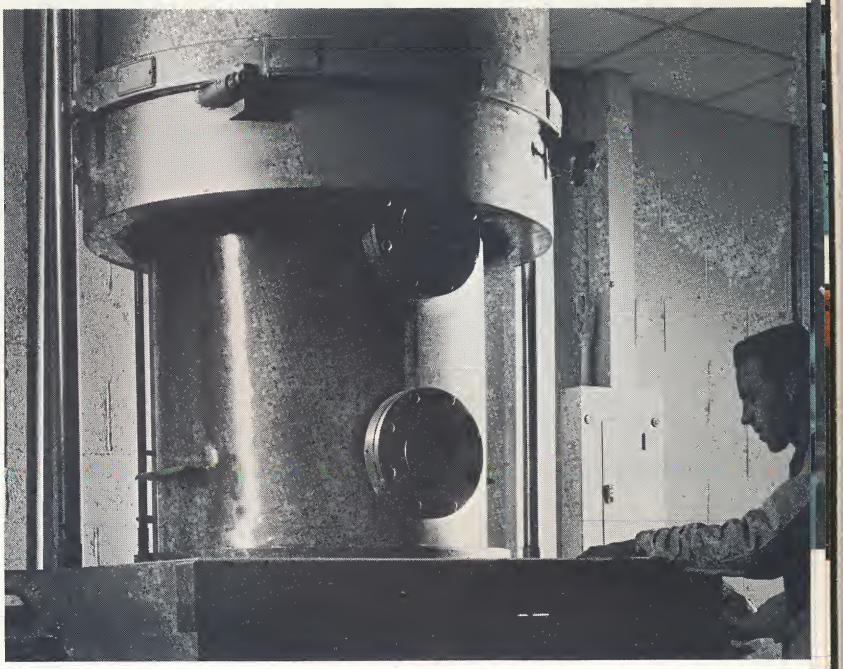


C

Infrared Industries has developed and is rapidly extending a capability in solid state technology, the key to advanced development of sources, optics, transducers and instrumentation for electro-optical systems. In-house projects include advanced sensors in the infrared region, solid state modulators and sources, solid state nuclear detectors and solar energy converters. In addition, in the field of instrumentation, the more effective utilization of solid state components to achieve stability and low noise continues to be a constant design goal.

The understanding by our scientists of the interaction between nuclear radiation and the solid state has led to the development of completely new solid state nuclear detectors and instrumentation, which are destined to assume a major place among the ranks of the established detector concepts, such as film, ionization chambers, geiger tubes and scintillation devices. At IRI, this technology has entered an exciting phase which is already bearing fruit in numerous applications to space radiation measurements. Even more important is the realistic promise of devices for commercial development.

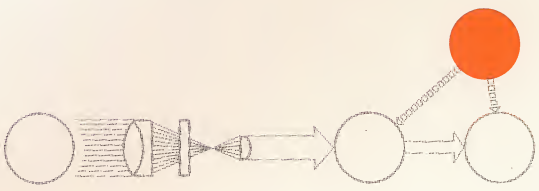
The inherent characteristics of solid state detectors and their associated instrumentation lead to obvious application in a number of scientific and technological fields. Many applications already exist in the fields of nuclear research, radio chemistry and nuclear chemistry research. The versatility and compactness of solid state detectors will also contribute strongly to improved and new industrial and medical applications.

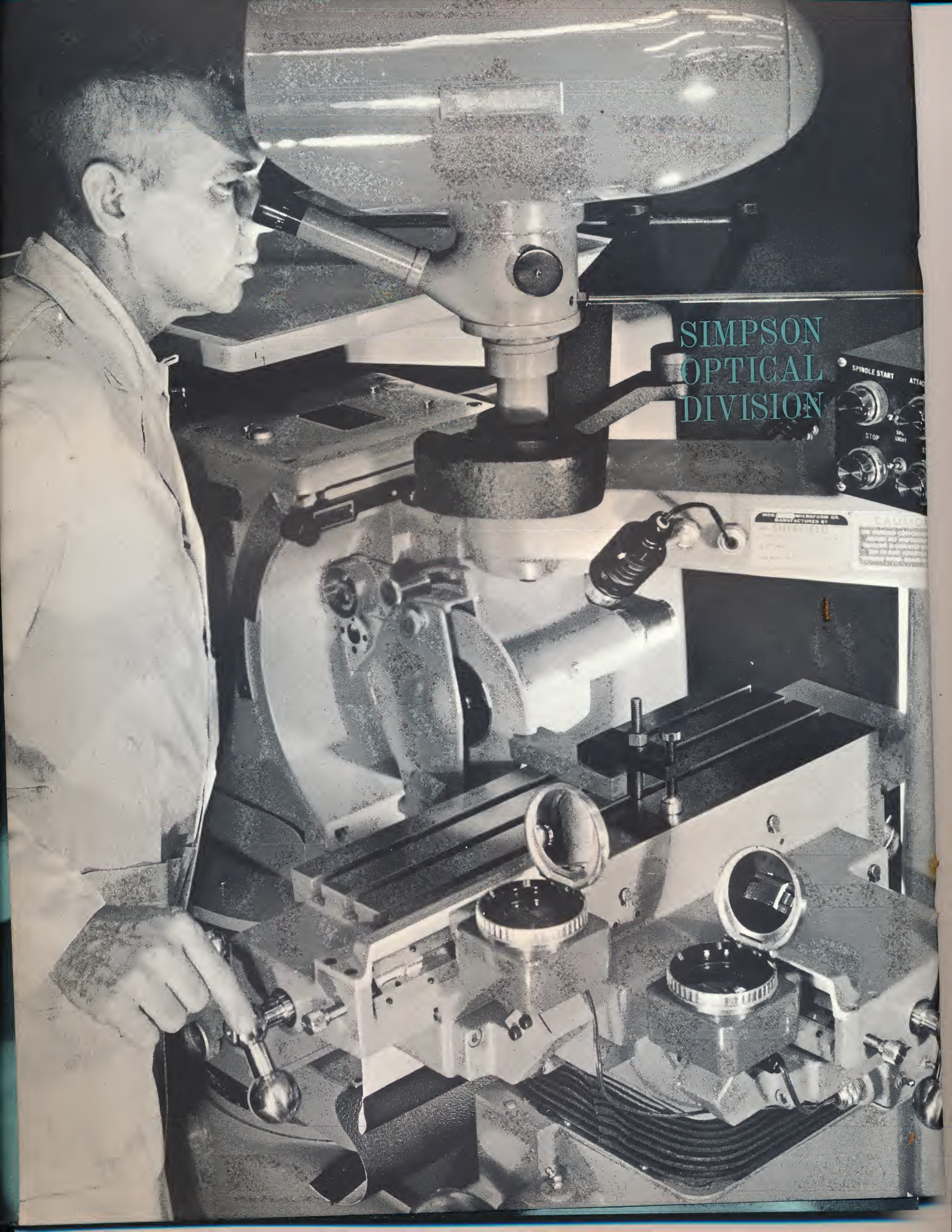
In space, solid state detector systems have demonstrated their usefulness by actual data obtained in a number of missions. They are being studied intensively for new and different space experiments by every major space research laboratory in the country. Our capabilities and the new requirements of space explorations will continue to provide mutual feedback toward a growing technology in these specialized sensor systems. Typical missions of the future include lunar probes, lunar stations, manned flight through Van Allen belts and in interplanetary travel, geophysical research space stations and nuclear power or energy substation platforms.

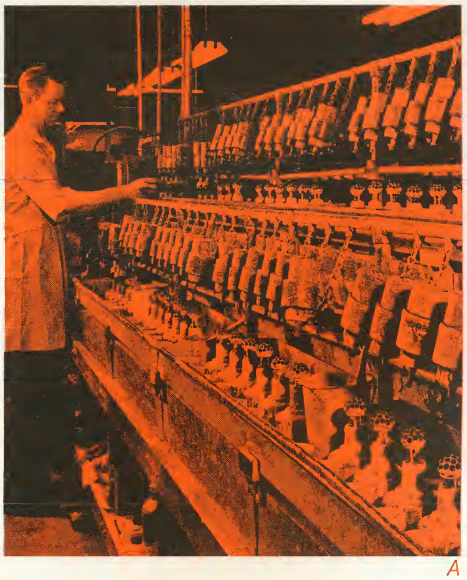
A Precision glassware, not obtainable from commercial sources, is custom-formed by skilled master glassblowers to provide special vacuum and cooling systems to enhance the performance of radiation transducers in the long-wavelength region.

B Research carried out in our chemistry laboratories supports IRI activities in solid state technology.

C Techniques for working with ultra-high vacuums have been developed by IRI engineers to provide greater refinement in the deposition of thin film electrodes for subminiature solid state components.




SIMPSON
OPTICAL
DIVISION
SPINDLE START
STOP



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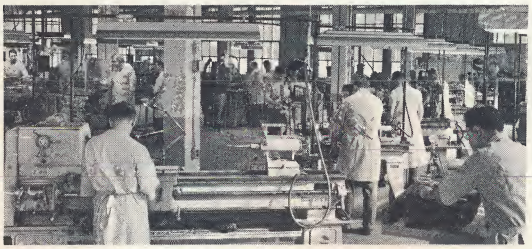

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The *Simpson Optical Division* of Infrared Industries, Inc. has been one of the nation's leading producers of precision optics for nearly four decades. Annual volume of this division is in the millions of units and includes precision lenses, prisms and mirrors in a wide variety of optical materials; camera, projector, microscope and telescope optics for science, industry and the home; precision optical alignment instrumentation for the machine tool industry; optical filters and reticles for resolving targets from backgrounds; and optical sighting, fire control and navigation equipment for military and aerospace programs. Defense contracts have encompassed developmental and production work for all branches of the Armed Services.

The Division's fully integrated scientific, engineering and manufacturing organization is housed in a new 45,000 square foot plant, built particularly for its highly specialized requirements, adjacent to Infrared Industries, Inc. corporate headquarters and Instrumentation Division in Santa Barbara, California. The equipment available to this Division's optical craftsmen includes both standard production processing equipment and ultra-precise special tools, affording the means to produce either highly precise individual prototypes or mass production duplicates. Since the accuracy of these operations is measured and controlled in terms of wavelengths of light, finishing, assembly and inspection functions are carried out in a specially-constructed "white room" which provides a particle-free, constant temperature and humidity controlled environment to assure that this accuracy carries through to the finished product.

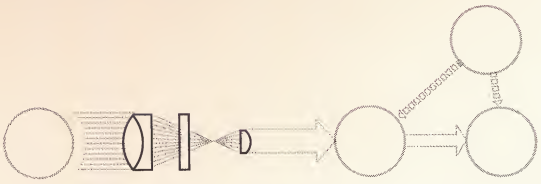
In addition to exacting optical characteristics, the encapsulation of these optical systems or components must be controlled to a degree of precision not considered feasible except in the laboratory a few years ago. Minimum tolerance mechanical parts whose dimensions, mass and dynamic balance can be accurately predicted, controlled and duplicated, are essential to the fulfillment of military and research specifications. The Simpson Division operates its own modern machine shop employing high speed multi-spindle metal working equipment, much of which is especially tooled for accuracies in excess of the machine tool manufacturer's guarantees. This capability provides the Simpson Division with a dependable, completely controlled source for the production of these important mechanical components.

A Mass production of optical elements requires specialized equipment and a vast stock of processing tools.

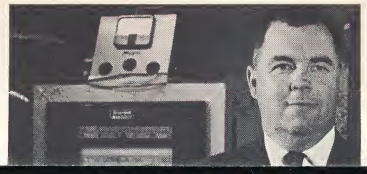
B Lens mountings machined to high precision. In one of the finest machine shops in the industry, the word "precision" takes on a new shade of meaning.

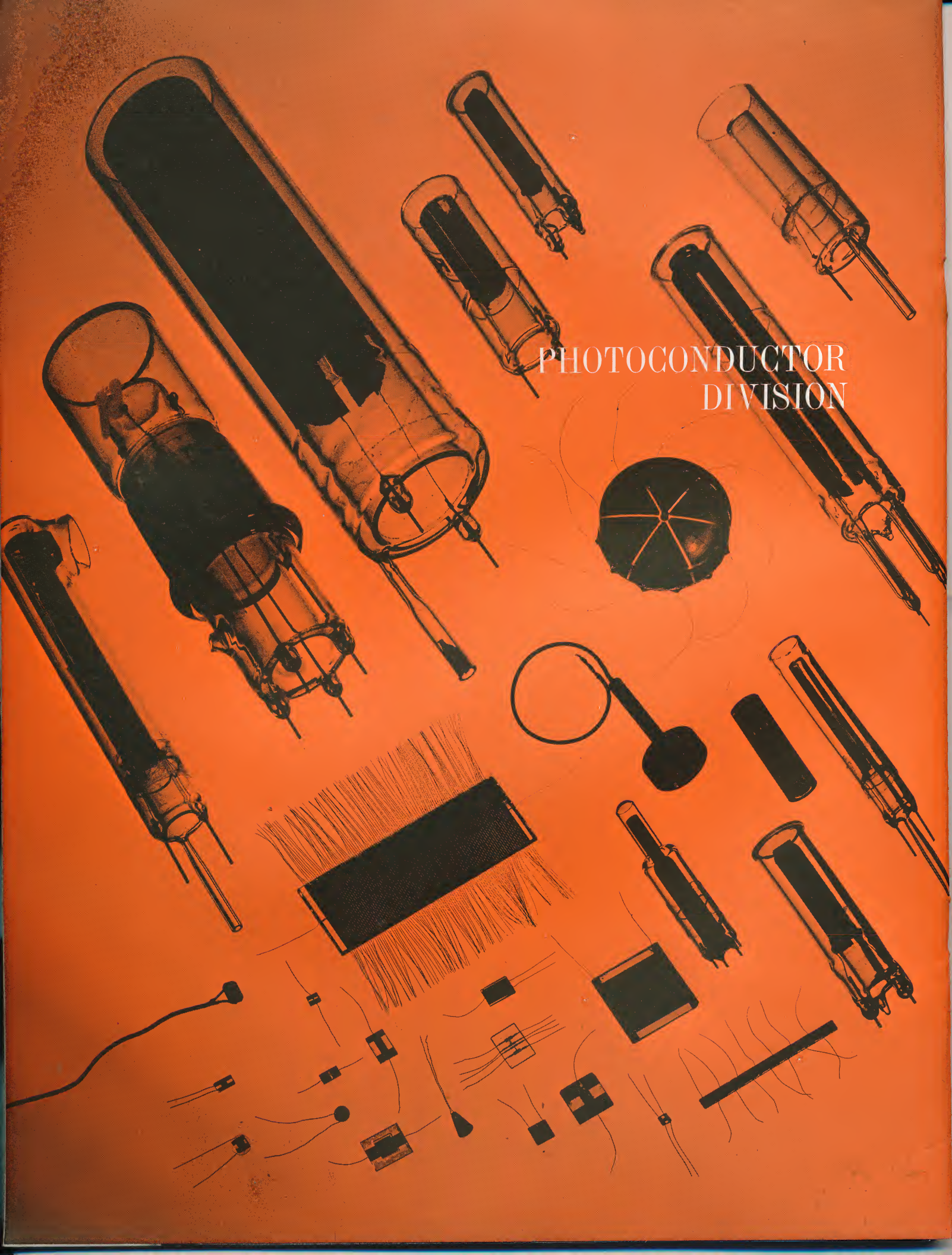
C Final inspection of optical elements is carried out under "white room" conditions of cleanliness and temperature and humidity control.

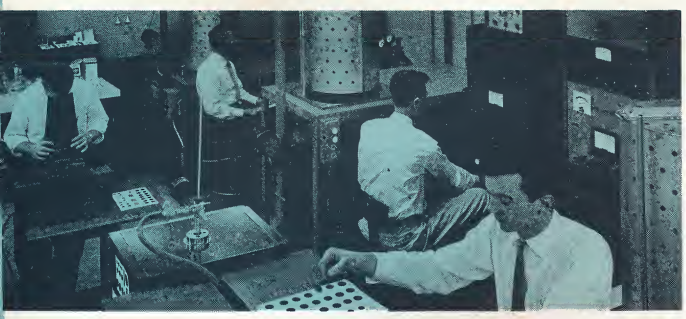
D Simpson Division products range from simple geometric optics, to complex lens assemblies, to complete electro-optical systems.



James F. Daley
Vice President & General Manager
Simpson Optical Division




PHOTOCONDUCTOR
DIVISION



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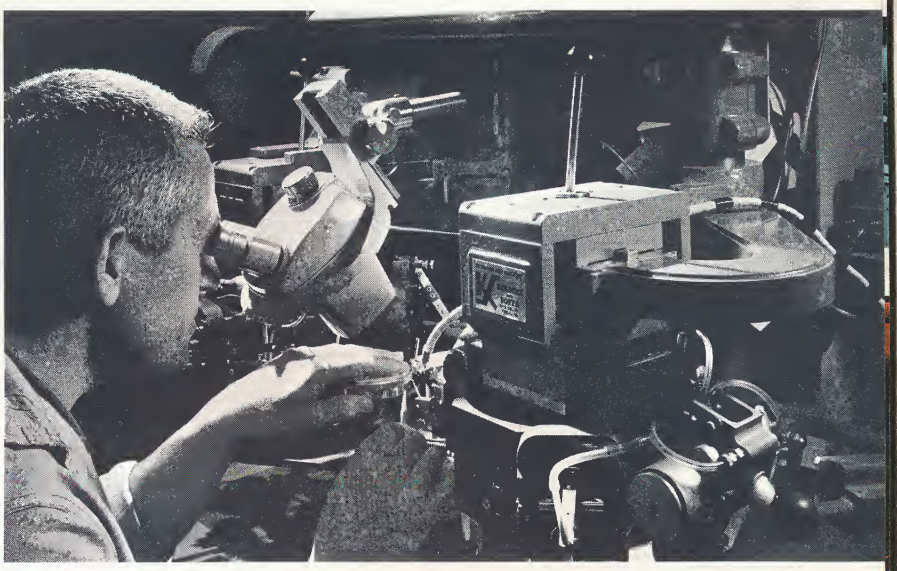


C

Establishment of Infrared Industries' *Photoconductor Division* in 1957 marked the beginning of the Armed Forces' dependence on precise, reliable sensors for infrared guidance and observation and a new era in industrial controls using electro-optical techniques. The division today is the world's largest producer of transducers for aerospace infrared missions and for industrial, commercial and consumer devices. Its units are in the famed Sidewinder air-to-air missile, the F-104 optical gunsight, the Mauler and Redeye missile programs and missile-detecting satellites.

This Division's unsurpassed reservoir of technical talent has produced many firsts in advancement of the state-of-the-art of electro-optical transducers. It has held a steady lead in the constant search for maximum sensitivity and stability of sensors, as well as in the development of multielement techniques for high resolution imaging concepts. Its unique production processing controls permit true mass production at minimum cost, thus making a science of what was formerly an art. To maintain the pace of advancement, it employs the most extensive detector measurement instrumentation in the country, including both production test consoles and research instrumentation for the complete investigation of all detector properties.

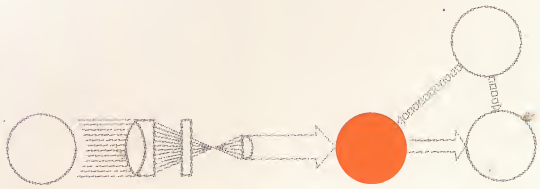
The Photoconductor Division has developed and manufactured an extensive line of optical interference filters and coatings for visible and infrared spectra and unique optic-detector combinations, where interface reflection losses are reduced to a minimum by deposition of the sensitive film directly on the filter or high index lens material. This capability includes laser coatings with up to 99.6 per cent reflectance. IRI filters contribute to many military and space programs as well as enhance the capability of industrial photoelectric and radiometric instruments.

The Division is housed in a new 30,000 square foot engineering and manufacturing facility in Waltham, Massachusetts, designed especially for transducer production. The building is temperature and humidity-controlled and accommodates the most modern of equipments for the development, fabrication and evaluation of detectors, detector packages and optical filters. Its facilities include a complete chemistry laboratory, glass-blowing department and engineering, testing and environmental laboratories.

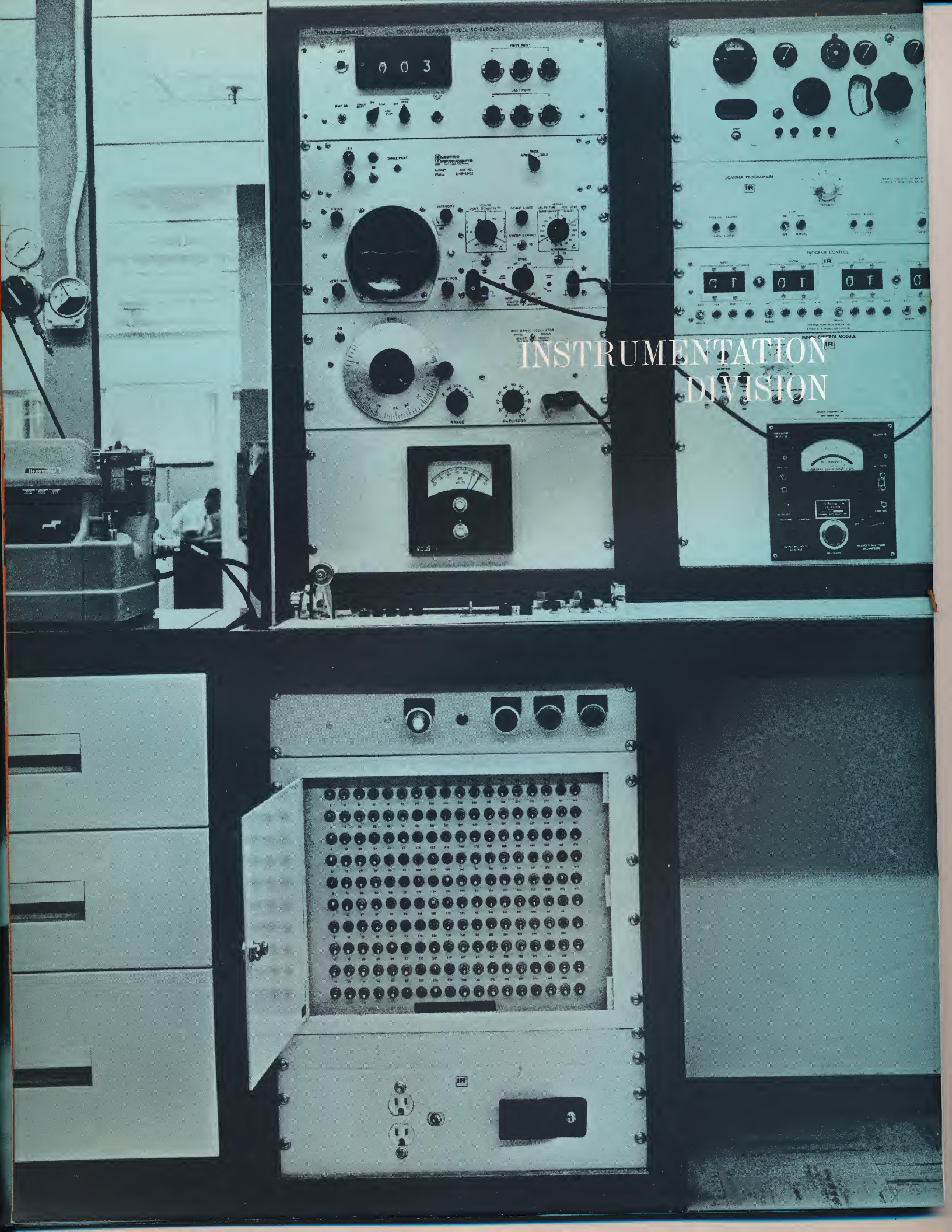
A Thin-film coatings, deposited on optical substrates in multiple layers of fractional wavelength thickness, are used to control transmission and reflection characteristics in optical systems.

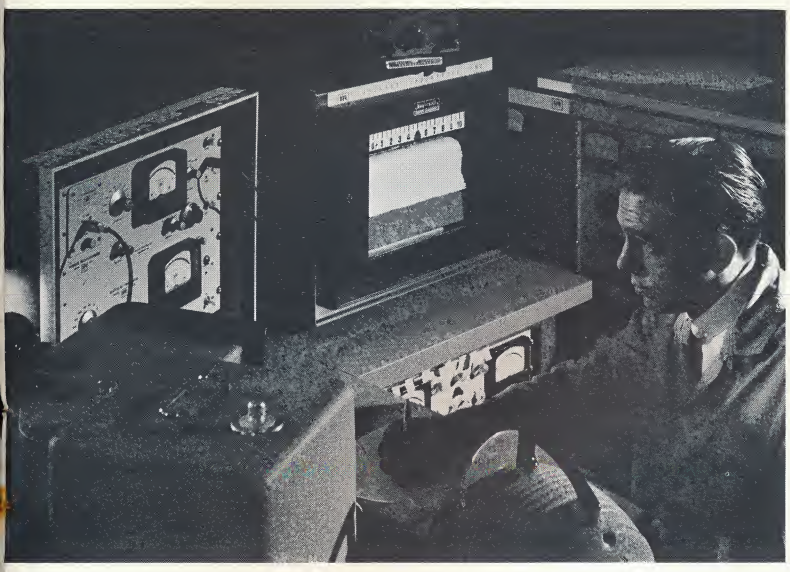
B Well over a million photoconductors, to a variety of specifications, have been produced in the Waltham, Mass. plant of the Photoconductor Division.

C Specially designed micromanipulation and microwelding equipment is used to produce multi-element photoconductor arrays which are microminiature in size.



William E. Standring, Jr.
Vice President and General Manager
Photoconductor Division


INSTRUMENTATION
DIVISION



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The firm technological base of the *Instrumentation Division's* achievements in electronics results from a unique history of experience in the processing of ultra-low level signals in the presence of inherently noisy electrical and physical environments. Originally stimulated by the demands for high standards in infrared detector measurement and calibration, the Instrumentation Division has successfully solved the most difficult of low-level signal processing problems and the non-ambiguous digitized measurement of random noise. These solutions have been transformed into quality production instruments.

Advantageously combining the best of analog and digital signal processing techniques, the engineering staff has instrumented display, readout and control functions to provide fully automated test laboratories. The wide-spread acceptance of these measurement consoles is chiefly due to features unique in the measurement field: completely self-contained environmental simulation and control and unparalleled accuracy and resolution of measurement.

IRI's Instrumentation Division has carried out a parallel and equally successful development and production program in the field of radiant energy sources and electro-optical instrumentation such as monochromators, comparators and collimators as well as ancillary mechanical equipment.

In the industrial control field, radiation thermometers, reliable presence detectors and electronic circuit monitors are combined with existing automatic digital equipment for real time data logging and closed loop process control.

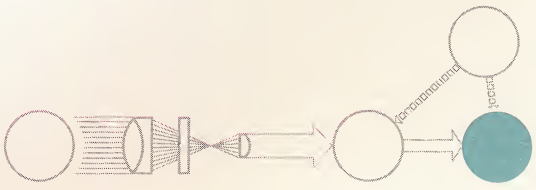
In addition to product and research depth, the Instrumentation Division maintains complete calibration and measurement standards with such facilities as a radiometric dark tunnel and contaminant-free "white room". The Division offers in-house analytical radiometric calibration and measurement services. Timely field-service engineering is augmented by technical representatives maintained nation-wide as well as in important overseas customer locations.

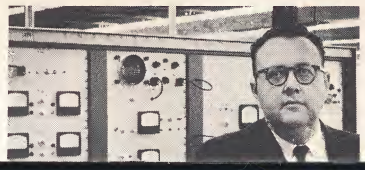
The Instrumentation Division is housed in a productivity-engineered installation of more than 30,000 square feet recently designated one of the nation's top ten industrial facilities and conveniently located in Santa Barbara, California.

A Typical radiation measurement instrumentation designed and produced by the Instrumentation Division includes this modified Leiss double monochromator system, with built-in calibration standards and optics, for making precise spectral measurements from the ultra-violet to the far infrared.

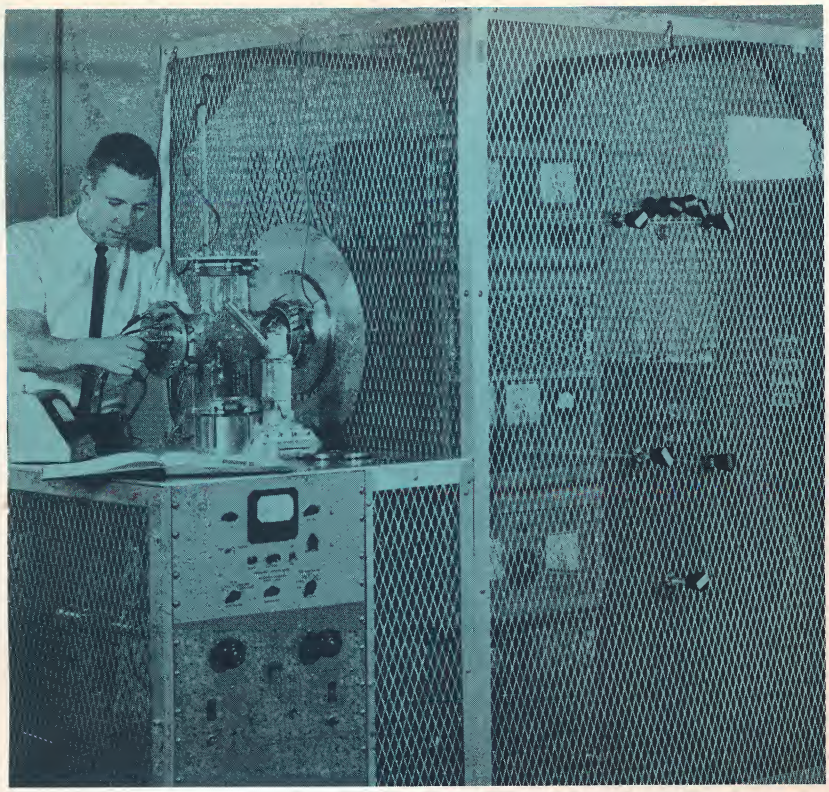
B IRI's Comprehensive Measurement Consoles are in operation in scientific and industrial facilities throughout the world.

C Final testing and calibration to assure the operational readiness of electro-optical instruments for industrial control applications.





Arthur J. Cussen
Vice President and General Manager
Instrumentation Division



This machine, designed and built by ENL scientists, provides high-resolution, mono-energetic electrons or protons, bremsstrahlung x-rays or neutrons from nuclear reactions.

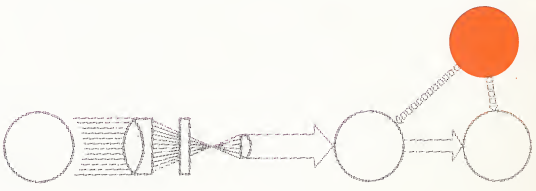
ELECTRO-NUCLEAR LABORATORIES, INC.

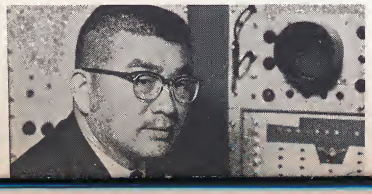
was formed as an affiliate of Infrared Industries, Inc. to provide the parent company with extended research, development and production capabilities in solid state nuclear detectors and associated instrumentation as well as to provide a facility for nuclear particle irradiation damage studies for its space projects.

Technical activities of the Division include lithium drifting and diffusion processing in semiconductor devices, high temperature diffusion of phosphorous and boron, thin film and single crystal research and development, studies of Van Allen Belt radiation damage, the development of nuclear surface-passivated particle detectors, nuclear instrumentation capable of spectroscopic usage, free carrier recombination radiation sources, solar simulators, fast pulsed optical sources operating in the nanosecond time constant region, and solid state modulators for the infrared region of the electromagnetic spectrum utilizing the principle of free carrier injection.

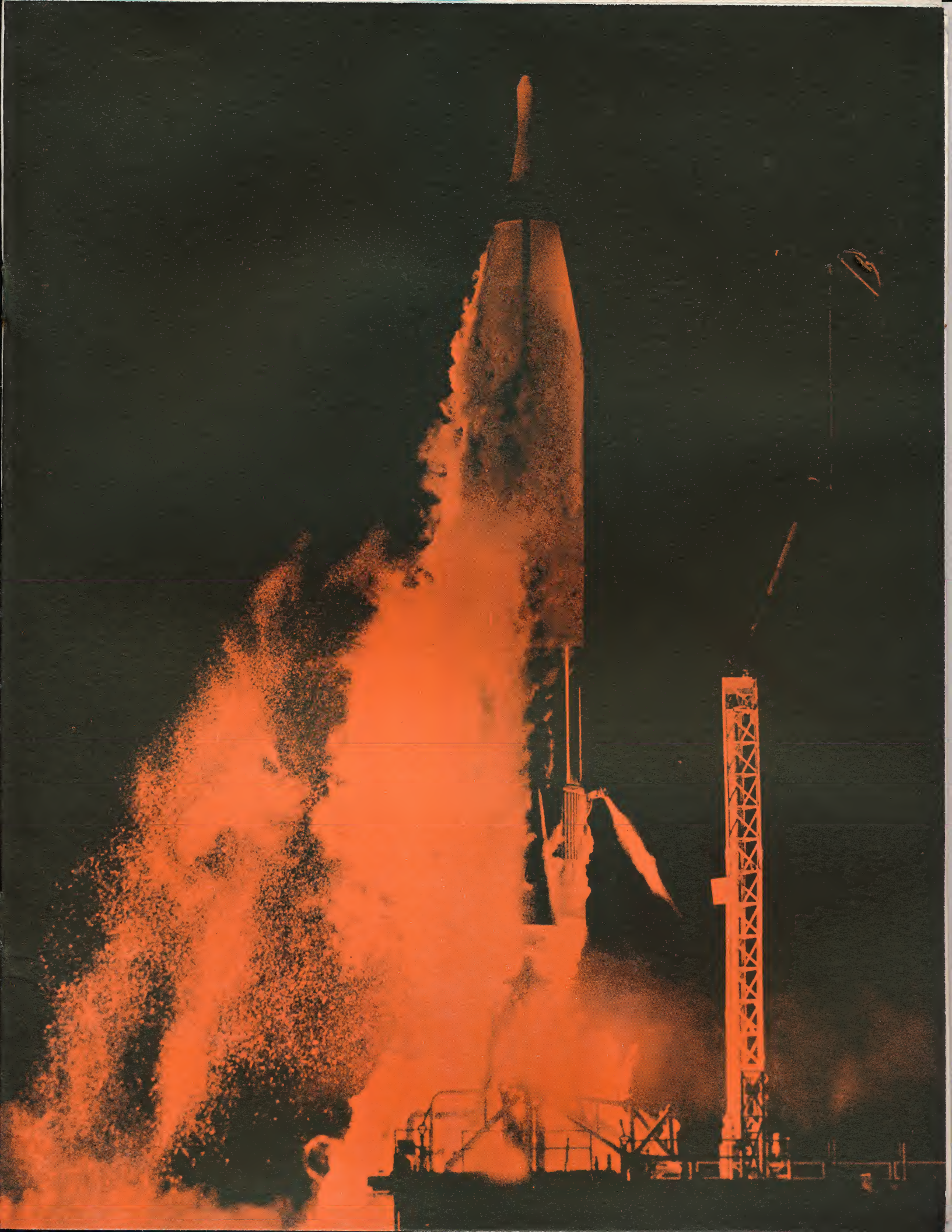
Research and development activities of Electro-Nuclear Laboratories, Inc. are centered in a new laboratory at Mountain View, California. Facilities of the laboratory include a dust-free "white room" with close temperature and humidity control for conducting exacting processes such as controlled diffusion in optical sensors, precise calibration of radiation detectors, and calibration and final preparation of optical detectors. Equipment of the most advanced design is maintained to keep pace with a rapidly progressing technology.

ENL radiation research has the goal of designing satellite payloads to withstand the intense radiations of outer space. ENL scientists are well versed in the design, construction and use of charged particle accelerators for this work as well as for nuclear radiation detector calibrations.





K. T. Chow
Vice President & General Manager
Electro-Nuclear Laboratories, Inc.



INFRARED INDUSTRIES, INC.

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